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I, JONNE YABSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PS 1642 for a patent by CUBE LOGIC SYSTEMS PROPRIETARY LIMITED as filed on 09 April 2002.

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WITNESS my hand this
Fifteenth day of April 2003

J R Yabsley

JONNE YABSLEY
<u>TEAM LEADER EXAMINATION</u>
<u>SUPPORT AND SALES</u>

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PROVISIONAL SPECIFICATION

Invention Title: CUBING APPARATUS AND METHOD

Applicant: CUBE LOGIC SYSTEMS PROPRIETARY LIMITED

The invention is described in the following statement:

Cubing Apparatus and Method

The present invention relates to an apparatus and method for the "cubing" or "dimensional weighing" of parcels and the like.

The cost to a postal carrier of delivering a parcel not only depends upon parcel weight, but also upon parcel size. Thus, due to the valuable extra freight space that a large parcel will occupy in a transport vehicle, a lightweight but large parcel will often cost a carrier more to transport than a heavy but small parcel.

To take account of this, carriers use the concept of "dimensional weighting" or "cubing" to calculate customer delivery charges.

In charging systems using this concept, a minimum chargeable weight per unit volume is adopted. A carrier thus determines a parcel's volume, and multiples this by a suitable amount to give a "dimensional weight", i.e. a minimum charging weight for the parcel. The carrier then compares this value with the actual weight of the parcel, and uses whichever is the heavier to charge the customer, e.g. by multiplying the selected weight by a suitable dollar per unit weight value.

Such systems more accurately reflect the true transport costs of a parcel, are fairer to all, and apply the "user pays" principle.

Unfortunately, however, the actual process of obtaining a dimensional weight can be somewhat cumbersome and time-consuming, and, at present, there is a lack of a practical and effective way of implementing "cubing" in e.g. a busy postal retail setting, such as a post office or the like.

Postal workers, therefore, often find that they are unable practically to implement cubing measurements, and instead merely charge on the basis of a parcel's actual weight. This can lead to significant revenue losses for the postal company/carrier involved.

An aim of the present invention is to provide an apparatus and a method for cubing parcels and the like, which is quick and simple to use, and which facilitates the proper charging of parcels at postal retail outlets and the like.

Viewed from one aspect, the present invention provides dimensional weighing apparatus for use with object weighing apparatus and object pricing apparatus, the dimensional weighing apparatus including:

sensing apparatus for determining size data for an object; and

control apparatus which receives size data from the sensing apparatus and which includes an interface for communicating with the weighing apparatus and an interface for communicating with the pricing apparatus;

the control apparatus in use being connected between the weighing and pricing apparatus, and outputting weight value information to the pricing apparatus dependent on weight data from the weighing apparatus and size data from the sensing apparatus.

The present invention provides a simple and effective system for automatically determining a dimensional weight for a parcel, which can be used transparently with scales (weighing apparatus) and cash registers (pricing apparatus) already existing in a postal outlet.

For example, in a typical postal counter set-up, a parcel is placed on a set of scales that then continuously outputs weight data, e.g. in the form of ASCII code, to a point-of-sale terminal, such as a cash register or the like. The cash register then converts the weight data into a corresponding postage charge based on e.g. whether the parcel is for domestic or international carriage or the like.

Using the present invention, the control apparatus may intercept the weight data from the scales, compare this with a dimensional weight determined using the sensing apparatus, and, when deemed necessary, substitute the actual weight with the dimensional weight.

The cash register will therefore always receive the correct parcel weight (either actual or dimensional) for use in its standard calculations for determining postage, and dimensional charging can be effected without change to the standard scales or cash register, and without intervention from the postal worker or retraining of the postal worker.

The cubing system is thus inexpensive and simple to install, as it uses existing equipment and requires no changes to that equipment. It can also provide an immediate increase in revenue to the user, as it enables proper dimensional weight pricing to be performed.

The control apparatus may output the weight data in any form expected by the cash register or the like, e.g. in ASCII code and e.g. in a continuous and repetitious manner.

The interfaces may take any suitable form, as required by the scales and cash register, and could e.g. be in the form of RS232 interfaces.

The sensing apparatus may take any suitable form, and may be provided in any suitable manner. Preferably, the sensing apparatus is configured to measure the size of the parcel whilst the parcel is on the weighing apparatus, e.g. is sized and shaped to be suitably positioned adjacent and/or over the scales. It is also preferably self-supporting, and further preferably uses sensors of a non-contact type. Such systems take up minimal extra counter space over that used by the existing scales and register, and a postal worker need only place a parcel on the scales and let the system do the rest. For example, the sensing apparatus could be mounted on a support stand, e.g. comprising a vertical strut and horizontal arm that in use extends over a measurement area. For example, the support could be of an inverted L or J shape.

It should be noted that the present invention would still provide substantial benefits over the present state of affairs, even if sensing was carried out separately from weighting, e.g. at a site adjacent the scales, and even if e.g. sensors were used that were hand-held or needed some human intervention.

The control apparatus may determine the dimensional weight in any suitable manner. It may for example determine the actual volume of the parcel, or it may determine the volume of the parcel assuming that the parcel has a set shape, e.g. cubic, cylindrical, oblong, a regular polyhedron or the like. It may also round dimensions up or down e.g. to the nearest inch, centimetre or the like, or may determine that a parcel is within one of a number of size ranges.

It may also use any suitable procedure to determine whether to send the dimensional weight or the actual weight to the cash register, e.g. it may merely determine which is the heavier of the two weights, and output that weight. It could however also implement further decision steps, e.g. only send the dimensional weight when the parcel volume or actual weight is above a set value, or it could send both a dimensional weight and an actual weight, e.g. if a cash register program were suitably modified to receive both.

The sensing apparatus may use any suitable sensors. It could for example use one or more video and/or digital cameras whose output, after any necessary digitisation, is analysed using suitable feature identification algorithms and the like. Preferably, however, the sensors sense the distance of

the object from them, e.g. in a line-of-sight manner, and preferably use electromagnetic or acoustic waves to sense the distance to the object. The sensors may comprise for example ultrasonic, microwave or laser sensors, which may measure distance using e.g. time-of-flight or interferometric methods.

The sensor outputs may be analogue or digital, and may for example provide an output proportional to the distance to the parcel. Their outputs may be biased, e.g. at the sensors or at the control apparatus, by e.g. a suitable voltage or digital value, so as to give a dimension of the object from e.g. the centre or one end of the measurement area, without needing a calculation step of this by the control apparatus.

The number of sensors used and the arrangement of sensors may vary dependent on the type of sensors used, the extent and accuracy to which the object's dimensions are to be determined and the manner in which the object's size is to be calculated.

Preferably, the sensors provide data on at least one cross-sectional profile of the object and at least one height measurement of the object.

The height of the parcel may be determined by one or more overhead sensors arranged substantially vertically over the object.

The cross-sectional data, e.g. a breadth and a width, may be determined by one or more substantially horizontally-mounted sensors.

The cross-sectional data may provide data on a full 360-degree profile of the object. This enables the apparatus to calculate the profile of objects that e.g. are not placed at the centre of the sensing area/scales or are of irregular cross-section.

Full 360-degree data may be obtained by having a number of sensors positioned about the object, but is preferably achieved by rotating the sensor arrangement and the object relative to one another, with the sensor or sensors taking measurements of the object profile during the rotation.

It is preferred to rotate the object, and to keep the sensors stationary, although rotating sensors (or both rotating sensors and a rotating object) would also be possible.

Preferably, the dimensional weighing apparatus includes a turntable on which the object is placed for size determination. The turntable preferably turns

the object whilst it is being weighed, and, although the scales could be mounted on the turntable, it is preferred to mount the turntable on the scales (with a suitable recalibration of the scales to take account of the turntable weight).

The turntable may be mounted on the scales in any suitable manner, e.g. it could be merely placed on top of the scales. It is preferably held in place by adhesive, a clamping action, or the like.

The profile is preferably obtained in one cross-section of a parcel using a single horizontally mounted sensor and a rotation of 360 degrees of the parcel. It would also however be possible to use two opposed sensors and a rotation of 180 degrees, three sensors and a rotation of 120 degrees, etc., i.e. "n" sensors and a 360/n degree rotation.

The turntable may be triggered to rotate in any suitable manner, e.g. through a sensor sensing the weight of an object placed on the turntable. Preferably, however, the turntable is connected to the control apparatus, and is activated by a signal from the control apparatus, e.g. when the control apparatus starts to receive a weight signal from the weighing apparatus.

The turntable may rotate in any suitable manner. It could for example be rotated manually, e.g. by a postal worker processing the parcel. The use of an electric motor is however preferred.

The turntable could for example rotate by a set angle at a time, e.g. using a stepper motor, and the control unit could take readings from the dimensional sensor or sensors after each step.

Preferably, however, the turntable rotates continually. The control apparatus may correlate the sensor readings with the position of the object by monitoring the position of the turntable and by taking sensor readings at set times in the rotation of the turntable.

The turntable position may be monitored by a sensor, such as an optical or magnetic encoder, which outputs a signal at a set angle of revolution of the turntable. The sensor may provide an output, e.g. a pulse, once every set number of degrees of revolution, with sensor readings being taken once every pulse or set number of pulses.

In one embodiment, the turntable is configured to rotate at a constant speed. The control apparatus can then sample the sensor readings at set time intervals and can correlate these to set angular positions of the turntable based

on the turntable speed. A rotation sensor may output a signal e.g. once per revolution to indicate when a full 360 degrees rotation has occurred.

Readings may be taken for one rotation, or for two or more rotations. When multiple rotations occur, the results may be averaged or otherwise compared e.g. to increase the accuracy of the measurements.

The turntable may include suitable supports for holding awkward shaped parcels in place during rotation. These could for example comprise a number of holes in the base into which pins or the like could be placed to hold the parcel.

The turntable may also include one or more guide elements for positioning the parcel on the centre of the scales, although a central location is not essential when a full 360 degree profile of the object is obtained.

The control apparatus may analyse the object profile in any suitable manner, and may firstly identify the number of sides of the object through the number of peaks or troughs in the profile, as these will generally correspond to corners of the objects or the centres of the sides of the objects. The control apparatus may then determine suitable dimensions of the object cross-section and/or the object's cross-sectional area using simple geometric techniques. It may for example for an oblong shape (having four peaks and four troughs) add the parcel dimensions at alternate peaks in order to obtain the diagonal lengths of the parcel cross-section or add the dimensions at alternate troughs to get the width and breadth.

The use of a parcel cross-section and height to determine volume assumes a constant profile for the parcel throughout its height, and this will be true in the vast majority of situations, e.g. where the parcel is a cube, oblong, cylinder or the like. Even when this is not the case, pricing structures often require charging based on the minimum cubic shape that would enclose the parcel (which can be determined from the maximum width, height and breadth of the parcel). The above method can therefore provide the correct dimensional weight for such pricing structures also.

The cubing apparatus could provide horizontal sensors at a number of different heights above the scales, so as to provide a profile of the object at each of these heights. This could provide a more accurate measurement of irregular shaped objects, and would allow the largest cross-section to be used

in the price calculations or would allow a more accurate determination of the actual volume of the parcel by using all of the profiles.

If a number of horizontal sensors are used one above the other, then parcel height could be determined by the height of the lowest sensor that did not register the parcel. This could remove the need for an overhead height sensor, if for example the horizontal sensors were spaced sufficiently closely to provide suitable height resolution.

In a further alternative, the apparatus could use a number of overhead sensors, e.g. in a linear array, e.g. along a radius of the measuring area. These sensors could e.g. be used to find a highest point of the object where this is not centred on the turntable. Also, the use of a number of vertical sensors could be used to provide the required horizontal profile of the object, and so could take the place of the horizontal sensors. With a rotating parcel and/or sensors, the array would only need to extend along one half of the measurement area, to measure the whole parcel.

It should be noted that the control apparatus, and the control steps carried out by it, may be implemented in any suitable form, e.g. through suitable software, firmware and hardware, as would be readily understood by a person skilled in the art.

The present invention also extends to a method of dimensional weighing or cubing using any of the above apparatus and features, and, viewed from a second aspect, the present invention provides a method of determining the dimensional weight of an object, the method including the steps of using one or more sensors to obtain size data of an object (e.g. as it is weighed on a set of scales), using the size data to determine a dimensional weight of the object, intercepting actual weight data of the object from a set of scales, and outputting weight data to a pricing apparatus based on the actual and dimensional weights.

The present invention also extends to a method of determining the dimensional weight of an object, the method including the steps of providing a turntable on a set of weighing scales, and using one or more sensors to obtain size data of the object as it is rotated on the scales during the weighing process, obtaining the size data and the output of the scales in order to determine a

dimensional weight and an actual weight of the object, and outputting weight data to a pricing apparatus based on the actual and dimensional weights.

Viewed from a further aspect, the present invention provides weight determining apparatus including sensing means for determining a dimension of an object to be weighed, and a control means which in use connects between a weighing apparatus for weighing the object and a pricing apparatus for pricing the object based on the weight, the control unit determining a weight value for the object based on the output for the weighing apparatus and the output of the sensing means, and outputting the weight value to the pricing apparatus.

Viewed from another aspect, the present invention provides a parcel cubing and weighting unit for use with a set of scales and a pricing terminal, the unit including an interface for communicating with the pricing terminal, an interface for communicating with the set of scales, one or more sensors for obtaining size data of a parcel, and a control for reading an actual parcel weight from the scales interface, for determining a size-equivalent weight based on the size data, and for outputting one of the two weights through the pricing terminal interface.

Viewed from a further aspect, the present invention provides dimensional weighing apparatus, which in use intercepts weight data that is output from scales for measuring the actual weight of an object and that is meant for receipt by a pricing terminal, and outputs to said pricing terminal either the actual weight data or dimensional weight data that is determined by the apparatus for the object.

The present invention need not only be provided as a retrofit system, but could be provided as a compete system, and, viewed from a further aspect, the present invention provides dimensional weighing apparatus including means, e.g. scales, for weighing an object, a turntable for rotating the object, one or more sensors for providing information on the size of the object as the object is rotated on the turntable, and a controller for determining a dimensional weight of the object based on the sensor information and the actual weight of the object based on the output from the weighing means.

It should be noted that any of the further aspects mentioned above may include any of the features mentioned in relation to the first aspect of the present invention.

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings. It is to be understood that the particularity of the drawings does not supersede the generality of the preceding description of the invention.

In the drawings:

Figure 1 a schematic side-view of a cubing and weighing system in accordance with one embodiment of the present invention;

Figure 2 is a top view of a parcel on the scales of the system of Fig. 1, showing the dimensions of a parcel's profile that are measured by a horizontal sensor of Fig. 1;

Figure 3 is a graph of the sampled output of a horizontal sensor of Fig. 1 plotted against rotational angle of the parcel; and

Figures 4a-4e show parcels of varying shape being weighed by the system of Fig. 1.

A system 1 for cubing and weighing a parcel 2 is shown in Fig. 1. Such a system may be used in e.g. a postal retail outlet, such as on a post office counter.

The system 1 may be provided either as a complete system, or in a retrofit manner using the weighing scales 3 and cash register 4 (or other point-of-sale/epos terminal) that are already on site.

In a standard postal counter system, when a parcel 2 is placed on the scales 3, the scales 3 outputs the parcel's weight continuously in ASCII code. The cash register 4 reads the weight data from the scales 3, and determines a suitable postage charge for the parcel 2.

The postage charge is based on the weight of the parcel, and also on other parameters manually input to the cash register 4. These parameters may include for example whether the parcel 2 is for domestic or international carriage, whether the parcel is to go by sea or air, and on e.g. premiums relating to recorded or registered delivery or the like.

The parcel 2 should also be priced based on its volume, e.g. according to the "cubing" or "dimensional weight" concept. Thus, an equivalent weight should be assigned to the parcel based on its volume and on a minimum chargeable weight per unit volume factor, and the heavier of the actual or equivalent weight should be used in charging. This step however is often not

performed due to the lack of suitable equipment for aiding postal workers to determine the equivalent or dimensional weight.

The present invention addresses this problem, in the retro-fit embodiment, by providing cubing apparatus 5 that may be transparently installed between the scales 3 and the cash register 4 to facilitate the dimensional weighing of the parcel 2, i.e. the pricing of the parcel based not only on weight but also on size.

The cubing apparatus 5 comprises a control unit 6 having an interface 7 for communicating with the scales 3 and an interface 8 for communicating with the cash register 4. These may for example take the form of RS232 interfaces.

The cubing apparatus 5 also includes a support stand 9, e.g. of an inverted substantially L- or J-shaped configuration, on which are mounted an overhead vertical sensor 10 located above the centre of the scales 3 for measuring the height of the parcel 2, and a horizontally-mounted sensor 11 for obtaining data on a cross-sectional profile of the parcel 2.

The sensors 10 and 11 are of a non-contact type, and may comprise for example ultrasonic, microwave or laser sensors. They may determine the distance between the sensor and a portion of the parcel 2 that lies within the line of sight of the sensor. Distance determination may be made using e.g. a time of flight or interferometric method.

The cubing apparatus 5 further includes a turntable 12 that is mounted on the scales 3, e.g. by adhesive or other suitable means, and that rotates the parcel 2 so that the horizontal sensor 11 may sense a full 360-degree profile of the parcel 2. The scales 3 should be re-calibrated to take account of the turntable weight.

The turntable 12 is controlled by the control unit 6, and is triggered to rotate by the control unit 6 when it starts to receive weight data from the scales 3 (as this indicates that a parcel 2 is on the scales 3). At the same time, the control unit 6 also triggers the sensors 10 and 11 to begin sensing.

Once the control unit 6 has recorded the distance measurement from the vertical sensor 10, it switches that sensor off, as only one reading is required. In order to build up a full 360-degree horizontal cross-sectional profile of the parcel 2, the control unit 6 continues to read the output of the horizontal sensor

11 for a full 360-degree rotation of the turntable before switching off both the turntable 12 and the horizontal sensor 11.

In order to correlate the data from the horizontal sensor 11 with the position of the parcel 2, the turntable 12 includes a position encoder 13. The encoder 13 outputs a pulse to the control unit 6 each time that the turntable 12 has rotated a set number of degrees. The encoder 13 may comprise an optical or magnetic encoder, as are known in the art, and e.g. may comprise a series of optical or magnetic elements mounted on the base of the rotating portion of the turntable, and an optical or magnetic sensor which outputs a pulse each time an element passes over it.

The control unit 6 uses the encoder pulses to sample the readings from the horizontal sensor 11, and so to correlate the position of the parcel 2 with the readings.

The speed of the turntable 12 and the resolution of the recorded profile will depend on the type of sensor 11 used. For example, a laser sensor may have a 1-degree resolution, whilst an ultrasonic sensor may have a 10-degree revolution. Thus, for an ultrasonic sensor, the control unit 6 may take readings every 10 degrees of rotation, and the encoder 12 may accordingly output pulses at each ten-degree rotation of the turntable 12. A full rotation may be achieved in e.g. about 4 seconds.

In order to determine the postage charge for a parcel 2, a user, e.g. a postal worker, places the parcel 2 on the scales 3, and, after waiting a short time for a 360-degree rotation of the turntable 12, reads the resulting charge for the parcel 2 from the register 4. The whole system is thus automatic and transparent to the user, and allows them to quickly and easily implement a cubing and weighing system, thereby generating increased income for the postal company involved.

Viewed from the apparatus side, once a parcel 2 is placed on the scales 3, the scales 3 will continually output the actual weight of the parcel 2 in ASCII code. The control unit 6 will note, through a change on the input of interface 7, that the scales 3 have begun an output, and will trigger the turntable 12 to rotate and the sensors 10 and 11 to begin to take readings.

The control unit 6 will then record the weight of the parcel from the output of the scales 3, and also the height of the parcel 2 from an output of the overhead sensor 10, and turn that sensor off.

The sensor 10 need only provide one reading, which the control unit 6 can then use to determine parcel height by reading the distance of the parcel from the sensor 10 and by subtracting this from the distance between the top of the turntable 12 and the sensor 10. This latter distance can be preset at e.g. 1 meter or just over this value (so as to provide a 1 m high sensing region), and may be measured exactly by the sensor 10 in an initialisation reading taken when no parcel is on the scales 2.

The control unit 5 also samples the output of the horizontal sensor 11 at set rotations of the turntable 12, as indicated by the pulses from the encoder 13.

These outputs allow the control unit 6 to determine the distances "X" shown in Fig. 2 between points on the outer periphery of the parcel 2 and the centre of the weighing scales 3. The control unit 6 obtains these measurements by reading the measured distance to the parcel 2 and by subtracting this from the known distance between the sensor 11 and the centre of the turntable, which is preset at e.g. 50 cm or just over this value (so as to provide a 1 m^2 horizontal measurement region).

Once the turntable 12 has turned through 360 degrees, the control unit 6 stops the turntable 12 and the sensor 11, and, if the parcel 2 is of oblong shape will have recorded a cross-sectional profile similar to that shown in Fig. 3.

The control unit 6 then analyses this profile in any suitable manner in order to obtain the dimensions and/or area of the parcel cross-section, and then obtains the parcel volume by multiplying the dimensions/area by the calculated height of the parcel.

In order to analyse the profile, the control unit 6 may first determine the number of peaks and/or troughs in the profile. These will correspond to the parcel corners and the centres of the parcel sidewalls. The control unit 5 can then determine the shape of the parcel's cross-section, e.g. a straight line would indicate a cylinder, and four peaks and four troughs would indicate a rectangle. The control unit 5 then uses simple geometric relationships to determine dimensions of the cross-section, e.g. it could add "opposing" trough dimensions

of an oblong profile to give a width or length of the parcel 2. In the case of an oblong shape, "opposing" troughs would be each alternate trough.

Once the control unit 6 has determined the parcel volume, it calculates an equivalent minimum weight by using an appropriate weighing factor or look-up table, and then compares this weight with the actual weight. Whichever of the two weights is the heaviest is then output via interface 8 to the cash register 4. The output data is presented in the same manner as the cash register 4 would expect to receive weight data from the scales 3, e.g. as a continuous output of the weight data in ASCII format.

The cash register 4 then calculates a postal charge for the parcel using the received weight data and the register's standard pricing algorithms.

It should be noted that a user does not need to precisely locate the parcel 2 at the centre of the turntable 12, since by obtaining a full 360-degree cross-sectional profile of the parcel 2, any off-centre placement is automatically taken into account.

The system described assumes that the cross-sectional profile will be constant throughout the height of the parcel 2. This will generally be the case, as the vast majority of parcels are cubic or oblong in shape, and other common shapes such as cylinders and the like are also accommodated. Even where a parcel is not of such a regular shape, a cubing system will often require that the price be based on a cube determined from the longest dimensions of the parcel in the height, width and breadth directions. The system will therefore generally accommodate such systems also.

If more details information on parcel volume is required, then for example extra horizontal sensors 11' could be added one above the other to provide cross-sections at various parcel heights. The largest profile could then be used to calculate the volume, or all of the profiles could be used to more accurately calculate the actual volume of the parcel or to take an average of the values.

Also, further vertical sensors 10, e.g. an array of sensors along a radius of the measurement area within which the parcel turns, could be provided, and the highest reading could be used as the parcel height or a height profile of the parcel could be calculated.

Figs. 4a-4e show various sized and shaped parcels 2 placed on the turntable 12. As shown in Figs. 4d and 4e, the turntable may include suitable

supports for holding awkward shaped parcels in shape, e.g. the turntable may include a set of holes 14 into which support pins 15 may be placed. Although not shown, a centring guide for placing the parcel centrally on the turntable could also be provided, although, as said, with the 360 degree profile of the parcel, centring is not a necessity.

The actual measuring area covered by the sensors could take any suitable size or form, but is preferably a cubic region preferably of about 1m x 1m x 1m. This limits the size of the parcels that can be passed over the counter. This can result in significant savings for the parcel carrier, as parcel systems are generally designed to work with standard sizes, e.g. a $1m^3$ cube or less, and parcels over this size need special handling often at high cumulative cost. The present system provides a physical barrier to anyone wanting to post parcels outside of the sensor size range, so that they can then be instructed on what alternative course of action to take, e.g. to take the oversize parcel to a specific parcel-handling centre.

It should be noted that the control process carried out by the control unit 6 may be implemented in any suitable form, e.g. in the form of suitable software, firmware and hardware, e.g. using a suitable microprocessor or the like.

It is to be understood that various alterations, additions and/or modifications may be made to the parts previously described without departing from the ambit of the present invention, and that, in the light of the teachings of the present invention, the weighing and cubing system may be implemented in any suitable manner.

For example, the cubing apparatus need not be provided as a retro-fit design, but could be provided as a complete system, in which case for example, the control unit 6 could be implemented in the cash register 4 or in the weighing scales 3, e.g. by suitable software or the like, and the turntable could be integral with the scales.

Also, the encoder 13 may output only one pulse per revolution, in which case the control unit 6 will sample the output of the sensor 11 at set time intervals and will correlate each sampled output to the parcel position based on the time the sample was taken and the speed of rotation of the turntable. The

turntable 12 should in this case use suitable motor means that allow it to be rotated at a constant speed.

If a number of horizontal sensors 11 are provided, then an overhead sensor 10 may not be needed, as the height may be determined by the first sensor beam not crossed by the parcel. Alternatively, if a plurality of overhead sensors 10 were used, then no horizontal sensor may be required, as a horizontal cross-sectional profile of the parcel could be obtained from the overhead sensors.

Instead of rotating the parcel, the sensors could be mounted for rotation or both parcel and sensors could rotate. It would also be possible not to rotate the parcel or sensors, and instead provide sensors fully about the turntable.

The outputs of the vertical and horizontal sensors 10 and 11 could be suitably biased (by the sensors or control unit 6) by a voltage or the like corresponding to the distance to the top or centre of the turntable respectively, so that the sensor outputs read are the actual parcel dimensions, and so that no intermediate calculation is then required by the control unit 6 to obtain the parcel dimensions e.g. as height or as distance of parcel periphery from the turntable centre.

Claims

1. Dimensional weighing apparatus for use with object weighing apparatus and object pricing apparatus, the dimensional weighing apparatus including:

sensing apparatus for determining size data for an object to be weighed; and

control apparatus which receives size data from the sensing apparatus and which includes an interface for communicating with the weighing apparatus and an interface for communicating with the pricing apparatus;

the control apparatus in use being connected between the weighing and pricing apparatus, and outputting weight value information to the pricing apparatus dependent on weight data from the weighing apparatus and size data from the sensing apparatus.

2. The apparatus of claim 1, wherein the control apparatus determines a dimensional weight for the object based on the size data, and outputs the larger of the dimensional weight and an actual weight of the object as determined from the weight data.

3. The apparatus of claim 1 or 2, wherein the control apparatus outputs the weight value information as ASCII code in a continuous manner.

4. The apparatus of any preceding claim, wherein the sensing apparatus is adapted to determine the size of the object whilst the object is on the weighing apparatus.

5. The apparatus of any preceding claim, wherein the sensing apparatus is self-supporting.

6. The apparatus of any preceding claim, wherein the sensing apparatus includes non-contact type sensors.

7. The apparatus of any preceding claim, wherein the sensing apparatus includes sensors that sense a distance to the object.

8. The apparatus of any preceding claim, wherein the sensing apparatus includes ultrasonic, microwave and/or laser sensors.

9. The apparatus of any preceding claim, wherein the sensing apparatus includes one or more vertically-mounted sensors arranged in use over the object.

10. The apparatus of any preceding claim, wherein the sensing apparatus includes one or more horizontally-mounted sensors.

11. The apparatus of any preceding claim, wherein the sensing apparatus and object rotate in use relative to one another.

12. The apparatus of any preceding claim, including a turntable on which the object is placed for size determination.

13. The apparatus of claim 12, wherein the turntable is adapted to be mounted in use on the weighing apparatus.

14. The apparatus of claim 12 or 13, wherein the turntable is connected to the control apparatus, and is activated by a signal from the control apparatus.

15. The apparatus of claim 12, 13 or 14, wherein the turntable rotates continually during sensing.

16. The apparatus of claim 15, wherein the turntable includes a rotation sensor for outputting a signal indicative of turntable position.

17. The apparatus of claim 16, wherein the rotation sensor outputs a signal once per revolution, and the turntable is configured to rotate at a constant speed.

18. The apparatus of any of claims 12 to 17, wherein the control apparatus correlates the size data with the rotational position of the turntable in order to determine a cross-sectional profile for the object.

19. The apparatus of any preceding claim, wherein the sensing apparatus provides data on at least one cross-sectional profile of the object and at least one height measurement of the object.

20. The apparatus of any preceding claim, wherein the sensing apparatus determines size data for a 360-degree profile of the object.

21. The apparatus of claim 19 or 20, wherein the control apparatus identifies the shape of the object through the number of peaks and/or troughs in the cross-sectional profile.

22. The apparatus of claim 21, wherein the control apparatus determines dimensions of the object cross-section based on the identified shape of the object, and on the dimension data for the object determined at the peaks and/or troughs of the profile.

23. The apparatus of any preceding claim, wherein the control apparatus determines a cross-sectional profile of the object using one or more equally spaced apart horizontally-mounted sensors and a rotation of the object by an angle of 360 degrees divided by the number of horizontal sensors.

24. The apparatus of any preceding claim, wherein the sensing apparatus including a plurality of horizontally-mounted sensors arranged in use to lie at a number of different heights above the weighing apparatus.

25. The apparatus of any preceding claim, wherein the sensing apparatus includes a plurality of vertically-mounted sensors arranged to in use lie above the object.

26. A method of determining the dimensional weight of an object, the method including the steps of using one or more sensors to obtain size data of an object, using the size data to determine a dimensional weight of the object, intercepting actual weight data of the object from a set of scales, and outputting weight data to a pricing apparatus based on the actual and dimensional weights.

27. A method of determining the dimensional weight of an object, the method including the steps of providing a turntable on a set of weighing scales, and using one or more sensors to obtain size data of the object as it is rotated on the scales during the weighing process, obtaining the size data and the output of the scales in order to determine a dimensional weight and an actual weight of the object, and outputting weight data to a pricing apparatus based on the actual and dimensional weights.

28. Weight determining apparatus including sensing means for determining a dimension of an object to be weighed, and a control means which in use is connects between a weighing apparatus for weighing the object and a pricing apparatus for pricing the object based on the weight, the control unit determining a weight value for the object based on the output for the weighing apparatus and the output of the sensing means, and outputting the weight value to the pricing apparatus.

29. A parcel cubing and weighting unit for use with a set of scales and a pricing terminal, the unit including an interface for communicating with the pricing terminal, an interface for communicating with the set of scales, one or more sensors for obtaining size data of a parcel, and a control for reading an actual parcel weight from the scales interface, for determining a size-equivalent weight based on the size data, and for outputting one of the two weights through the pricing terminal interface.

30. Dimensional weighing apparatus configured in use to intercept weight data that is output from scales for measuring the actual weight of an object and is meant for receipt by a pricing terminal, and to output to the pricing terminal either the actual weight data or dimensional weight data determined by the apparatus for the object.

31. Dimensional weighing apparatus including means for weighing an object, a turntable for rotating the object, one or more sensors for providing information on the size of the object as the object is rotated on the turntable, and a controller for determining a dimensional weight of the object based on the sensor information and for determining the actual weight of the object based on the output from the weighing means.

DATED: 9 April 2002
Phillips Ormonde & Fitzpatrick
Attorneys for:
Cube Logic Systems Proprietary Ltd

David B Fitzpatrick

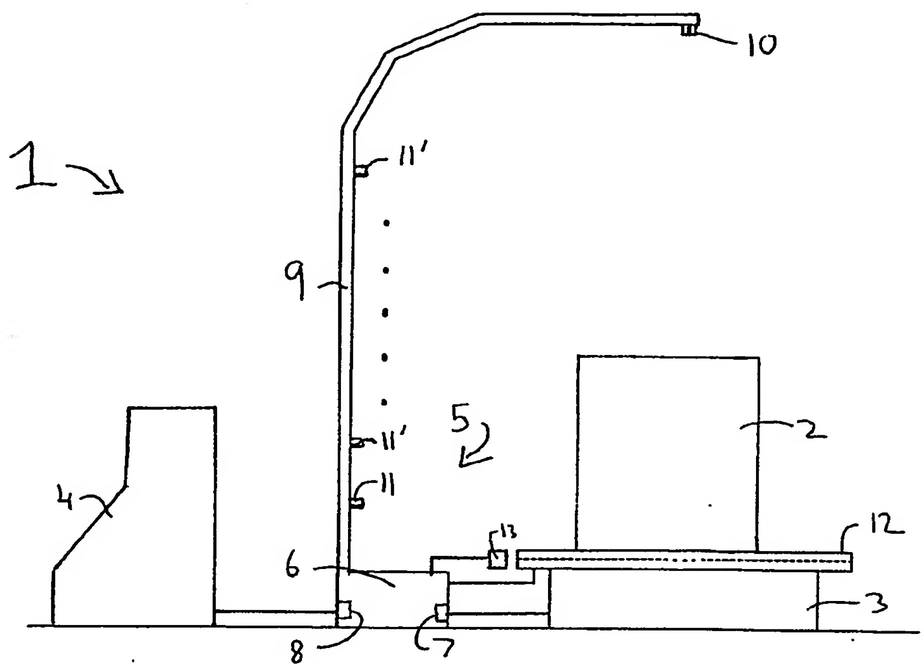

Fig. 1

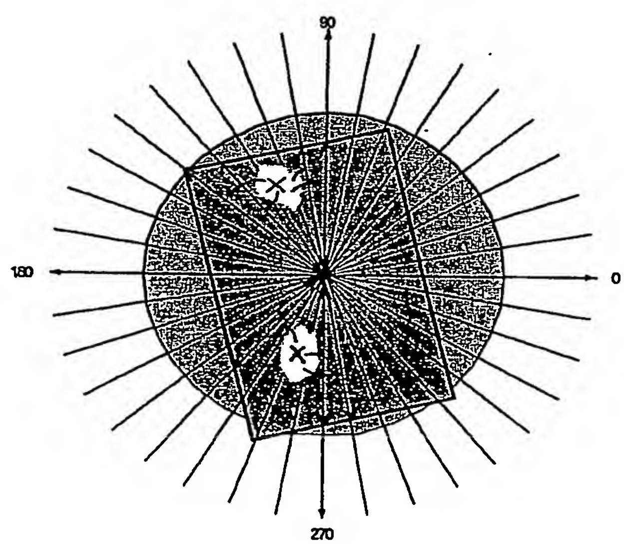

Fig. 2

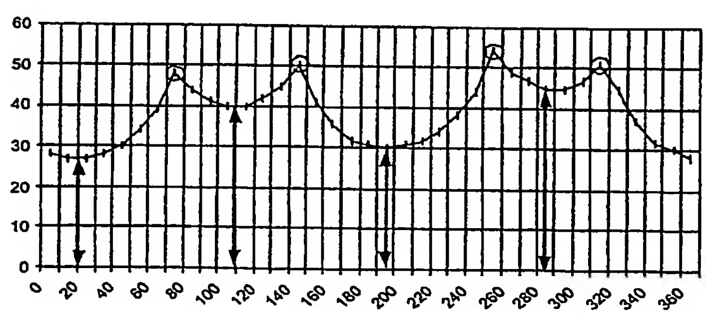

Fig. 3

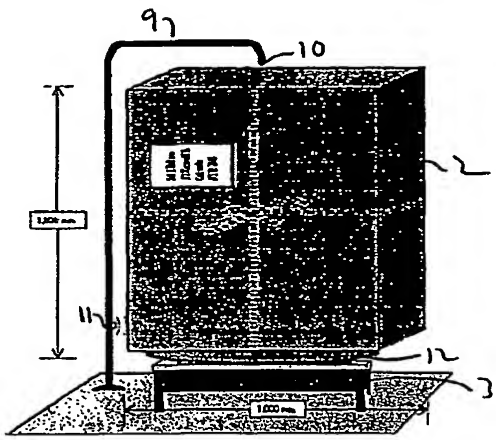

Fig. 4a

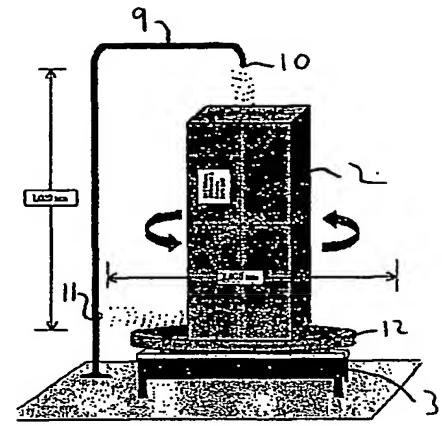

Fig. 4b

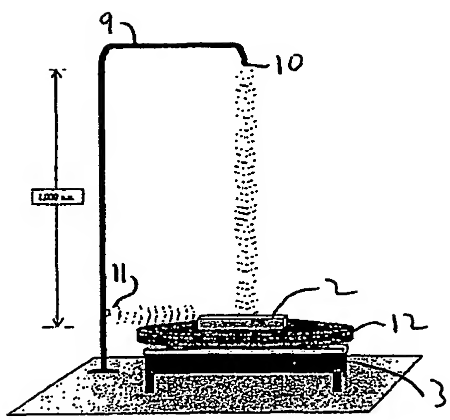

Fig. 4c

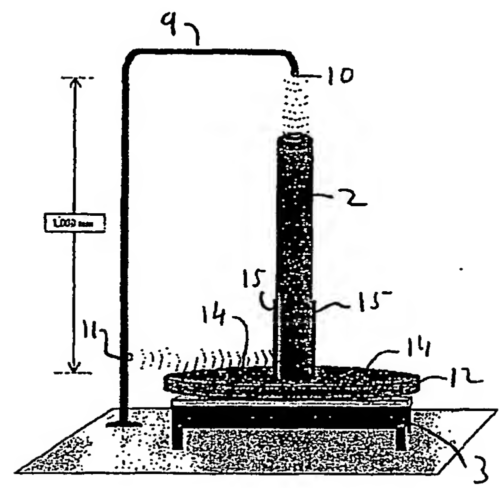

Fig. 4d

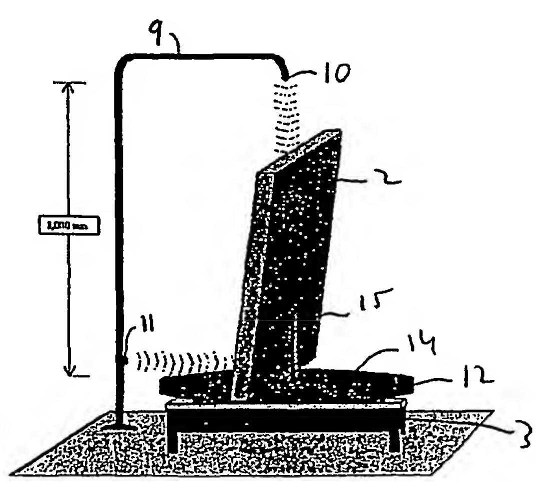

Fig. 4e